

國立成功大學

115學年度碩士班招生考試試題

編 號：49

系 所：機械工程學系

科 目：動力學

日 期：0203

節 次：第 2 節

注 意：1. 可使用計算機
2. 請於答案卷(卡)作答，於
試題上作答，不予計分。

※ 考生請注意：本試題可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

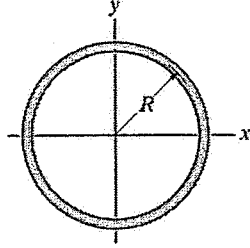
一、選擇題：(10 分，每題兩分)

1. (2%) A rigid body moves in a plane. At a certain instant, two arbitrary points A and B on the body have the same velocity magnitude and the same velocity direction.
Which of the following statements is always true?
 - (A) The rigid body is undergoing pure translation
 - (B) The rigid body is undergoing pure rotation about a fixed point
 - (C) The rigid body is undergoing general plane motion (translation + rotation)
 - (D) The angular velocity of the rigid body must be nonzero

2. (2%) A rigid body is rotating in a plane about a fixed point O. At a given instant, which of the following statements is always true?
 - (A) All points on the body have the same linear velocity.
 - (B) The linear velocity of any point on the body is perpendicular to the line connecting that point to O.
 - (C) The linear acceleration of any point is always directed radially toward O.
 - (D) The linear acceleration of any point is always proportional to its linear velocity.

3. (2%) A wheel of radius R rolls without slipping on a horizontal surface with its center moving to the right at a constant speed v . At the instant shown, where is the instantaneous center of zero velocity of the wheel located?
 - (a) At the center of the wheel
 - (b) At a point on the wheel located a distance $\frac{R}{2}$ below the center
 - (c) At the topmost point of the wheel
 - (d) At the point of contact between the wheel and the ground

4. (2%) The figure shows a uniform thin circular ring of mass m and radius R , lying in the $x - y$ plane and centered at the origin. What is the mass moment of inertia of the ring about the z -axis?

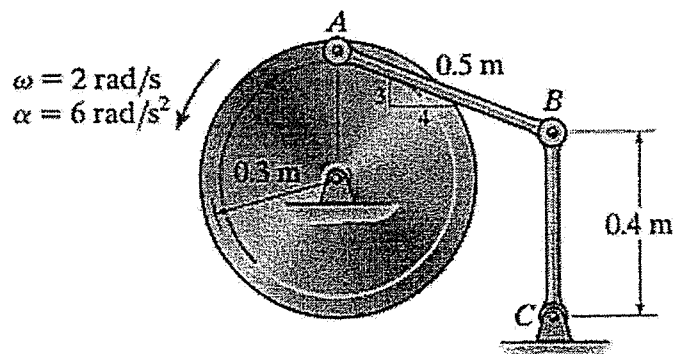


Prob. 4

- (a) $I_z = \frac{1}{2}mR^2$
- (b) $I_z = mR^2$
- (c) $I_z = \frac{1}{2}mR^2 + mR^2$
- (d) $I_z = \frac{1}{4}mR^2$
5. (2%) A particle moves with velocity v_r relative to a reference frame that rotates with a constant angular velocity ω . Which of the following correctly represents the Coriolis acceleration of the particle?
- (a) $a_C = \omega \times v_r$
- (b) $a_C = 2 \omega \times v_r$
- (c) $a_C = v_r \times \omega$
- (d) $a_C = \dot{\omega} \times r$

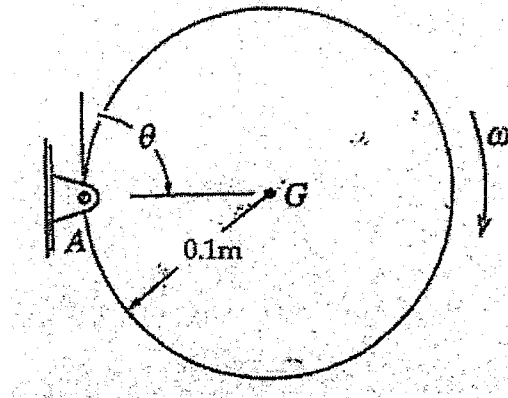
二、計算題

1. (20%) The flywheel rotates with angular velocity $\omega = 2 \text{ rad/s}$ and angular acceleration $\alpha = 6 \text{ rad/s}^2$. Determine the angular acceleration of links AB and BC at this instant.



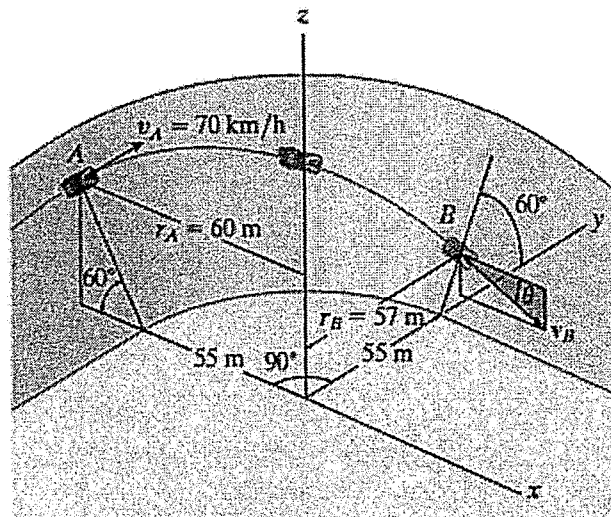
Prob. 1

2. (20%) The 20-kg disk is rotating about pin A in the vertical plane with an angular velocity $\omega = 4 \text{ rad/s}$ when $\theta = 0^\circ$. Determine its angular velocity at the instant $\theta = 90^\circ$. Also compute the vertical component of reaction at A at this instant.



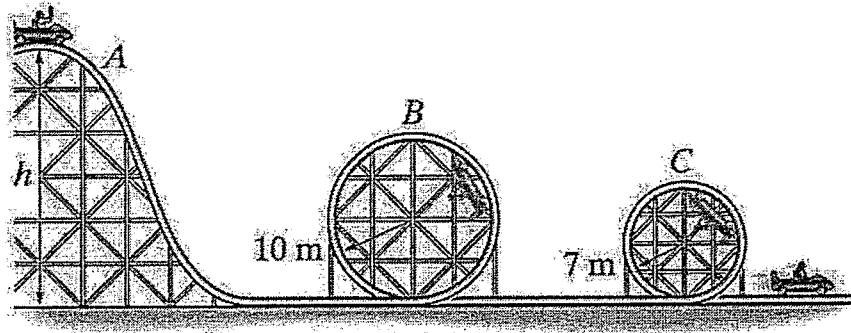
Prob. 2

3. (15%) A toboggan and rider, having a total mass of 150 kg, enter horizontally tangent to a 90° circular curve with a velocity of $v_A = 70 \text{ km/hr}$. If the track is flat and banked at an angle of 60° , determine the speed v_B and the angle θ of "descent," measured from the horizontal in a vertical $x-z$ plane, at which the toboggan exists at B. Neglect friction in the calculation.



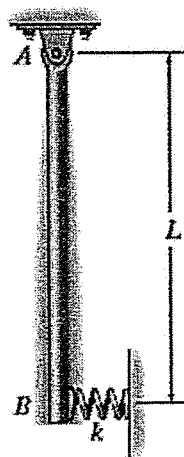
Prob. 3

4. As shown in the Figure, the roller coaster car has a mass of 1000 kg, including its passenger. If it is released from rest at the top of the hill A, determine the minimum height h of the hill crest so that the car travels around both inside the loops without leaving the track. $\rho_B = 10\text{ m}$ and $\rho_C = 7\text{ m}$ (10%). With the minimum height h , determine the normal force at point B and point C. (5%). Neglect friction, the mass of the wheels and the size of the car.



Prob. 4

5. (20%) The uniform rod of mass m is supported by a pin at A and a spring at B . If B is given a small sideward displacement and released, determine the natural period of vibration.



Prob. 5